## New LCA Software

# ICT for Environment in Life Cycle Applications
# openLCA – A new open source software for Life Cycle Assessment

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This paper is a two-fold introduction. For one, it introduces a new, open source, LCA software. Second, it is to establish a new section in Int J LCA named 'LCA Software'. Herewith, the editors of the journal recognise the growing possibilities and the impact of software, meaning both databases and calculation as well as modelling software, for practical applications as well as for the scientific development in LCA. This section is designed to house a broad variety of papers to be LCA focused and related to ICT (Information and Communication Technology). In this sense, announcements (as this one), conference reports, but also peer-reviewed papers on methodology and case studies, are most welcome.

**openLCA – A new, open source, LCA software**

A new LCA software is currently being developed by Green DeltaTC. The software will be made available as open source and designed as a highly modular, flexible framework, allowing different plug-ins and modules to be included. Some of the modules will also run as stand-alone applications. As a first module, a **format converter** for the conversion of LCA data formats has been released as open source in May 2007. The final release of the framework is scheduled for spring 2008, the release of an alpha version for summer 2007.

**Features**

**The openLCA framework** is developed in Eclipse, a Java-based Integrated Development Environment from IBM, which is open source itself. Eclipse provides an efficient Service Oriented Architecture (SOA) model; in fact, it is the reference application for SOA which is frequently implemented in major business software. SOA's practical consequence is a highly modular software which is easy to tailor to specific needs, even at runtime, with modules that run, optionally, as independent software applications. This allows to implement a broad variety of different methods and add-ons, yielding a rich-featured framework while simultaneously keeping the application small. Further, it provides an intuitive and fast user interface for applications, overcoming an old drawback of Java programs. Additionally, we will integrate other open source packages and software, for example for visualising the inventory network of processes.

The **format converter** (**Fig. 1**) is part of the framework; it converts current versions of LCI datasets from EcoSpold (ecoinvent), SimaPro EcoSpold, ISOTS14048/IMI (Chalmers), and ELCD (Joint Research Centre of the European Commission) from one format into the other and is able to produce datasets that are valid against the schema of 'their' format. The converter runs as a stand-alone application and can convert multiple data sets in batch mode. Future versions are expected concerning, e.g., updates of the implemented formats.
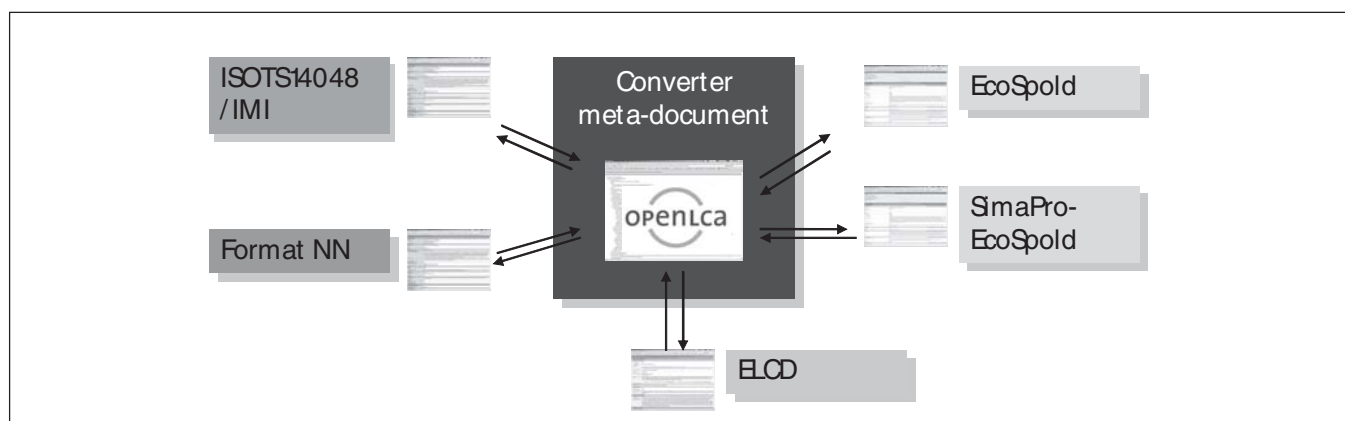


**Fig. 1:** The format converter meta-document as a central link between important LCA data formats
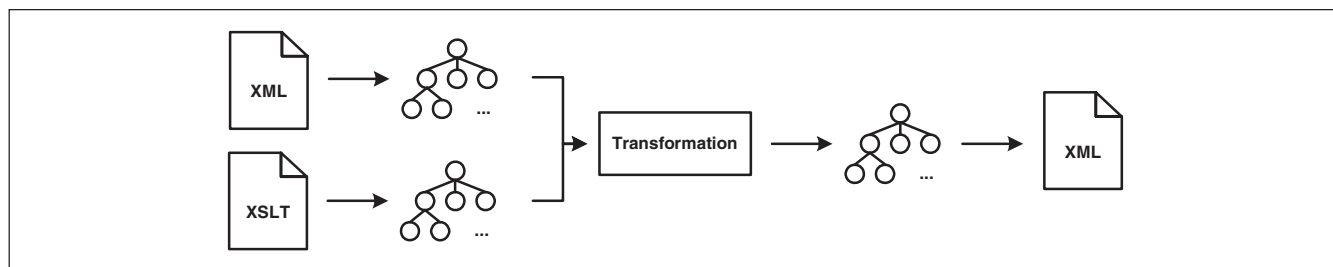
**Fig. 2:** The format conversion procedure (explanation see text box)

The **procedure for converting the formats** from one into the other is as follows **(Fig. 2)**: When the source file and the target format is selected by the user, the converter identifies and validates the format of the source file and then creates, as first step in the conversion, a meta-document where, via XML and XSLT, all information from the source file is mapped into a tree structure. The meta-document is a XML file itself, with an own schema, which implements a meta-format that is a unification of all implemented formats so far. This meta-document is saved. It contains all information in one file, also for formats such as ELCD which distribute the information for a process data set among several files. In a next step, the meta-document is transformed according to the target format, mapping content and, for some, attributes also the used nomenclature. Finally, the transformed meta-document is cleaned up, removing content not necessary for the target file, and rearranging XML branches according to the target format. These steps are performed in memory and not in the saved file. The result of this step, however, is saved as data set in the target format. For the ELCD format, for example, the whole directory structure for the ELCD database needs to be created.

## Implications

The project will have implications on several levels, from the open-source nature of the tool and its modularity to the specific features of the format converter.

The open-source character of the software allows, actually everyone worldwide, to modify and adapt the software to specific needs. This implies more independence and flexibility for users and requests the project to be responsible for the provision of clear documentation and source code; further, it provides the software development more independence from the initiating group.

The software is free to use opening applications where licence fees are critical. Due to its modular architecture, different plug-ins can be provided by different parties.

Choosing a dataset format for LCA with the format converter is not any longer only a matter of 'philosophy'; rather, users can, quite rationally, select the format that stores best the data they need for a special purpose. This in turn will improve the workflow in conducting LCAs where, according to our own experiences, data set conversion is one of the least wanted but often necessary tasks, and error-prone when done manually. By providing the converter, we look forward to improving data availability by easier data exchange, and to making LCA model quality benefit from better data.

## Organisation

The project consists of a core project team, a funding consortium, advisors, testing institutions and individuals, and, quite basically, users having downloaded the software and

are providing feedback. In the near future, external contributors will be included as well. In January 2007, PRé Consultants was the first to join the funding consortium, and PE International followed in March. We hope to announce future members soon. One motivation to join is 1. to support the open-source idea for LCA applications, 2. to foster the application of LCA worldwide, and 3. to improve data exchange; another motivation may be the practical advantage that consortium members can receive the software licensed, which allows the combination with other software products more easily (for details please consult the project website). And finally, consortium members receive the releases in advance, hence being able to provide feedback and give suggestions for the implementation (for example, the batch mode of the converter is such a suggestion).

## Getting involved...

If you are interested in either contributing, funding or testing, then please let us know. We, in turn, hope to get institutions and individuals involved, in order to make the openLCA project and software a lively, shared, 'peer' undertaking.

## Resources

Ciroth A (2006): A new open source LCA software. 7th Ecobalance Conference, Tsukuba 2006, Proceedings
Project website: http://openlca.org
Download site for public releases: http://sourceforge.net/projects/openlca
Newsletter: Send an email to gdtc@greendeltatc.com with the theme line "openLCA: please send newsletter"

## Publications by Andreas Ciroth in Int J LCA

Ciroth A, Becker H (2006): Validation – The Missing Link in Life Cycle Assessment. Towards pragmatic LCAs (Editorial). Int J LCA 11 (5) 295–297
Ciroth A, Fleischer G, Steinbach J (2004): Uncertainty Calculation in Life Cycle Assessments: A combined model of simulation and approximation. Int J LCA 9 (4) 216–226
Ciroth A (2004): Announcing the New Section 'Uncertainties in Life Cycle Assessment'. Int J LCA 9 (3) 141–142
Ciroth A, Fleischer G, Gerner K, Kunst H (2003): A New Approach for a Modular Valuation of LCAs. Int J LCA 8 (5) 273–282
Ciroth A, Hagelüken M, Sonnemann G, Castells F, Fleischer G (2002): Geographical and Technological Differences in Life Cycle Inventories Shown by the Use of Process Models for Waste Incinerators. Part 2: Technological and Geographical Differences. Int J LCA 7 (6) 363–368
Ciroth A, Hagelüken M, Sonnemann G, Castells F, Fleischer G (2002): Geographical and Technological Differences in Life Cycle Inventories Shown by the Use of Process Models for Waste Incinerators. Part 1: Technological and Geographical Differences. Int J LCA 7 (5) 295–300
Ciroth A (2002): Error Calculation in Life Cycle Assessments (New LCA Theses). Int J LCA 7 (5) 310
Huijbregts M, Norris GA, Bretz R, **Ciroth A**, Maurice B, von Bahr B, Weidema BP, de Beaufort ASH (2001): Framework for Modelling Data Uncertainty in Life Cycle Inventories. Int J LCA 6 (3) 127–132